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THESIS

THE APPLICABILITY OF COSMOS TO THE DEVELOPMENT OF THE SUBMARINE RADIOMAN CAREER MODEL

by

Jose M. Lamberty

September 2008

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13. ABSTRACT (maximum 200 words)

The thesis consists of two parts, a flow model and a data analysis section. The flow model is used to lay out the career path of an enlisted Navy radioman from accession (E-1) until the point he becomes a United States Navy Chief Petty Officer (E-7). This is the first time enlisted flows have modeled.

Part two of this thesis is the analysis of enlisted radioman data from October 1998 until September 2007. The data set was compiled from the Proxy Perstempo file maintained by the Defense Manpower Data Center (DMDC) containing monthly information on all active component personnel in the Navy.

We can conclude that demographic variables are not good predictors for individuals' promotion to E-7. Nevertheless, according to the Clementine software, MAX.EDU seems to be the strongest non-demographic variable. This result is analogous to the promotion parameters used to calculate the Final Multiplication Score (FMS). In the FMS computation, education can account for up to 2% of the total score. The use of this model will allow for the implementation in simulation software and the creation of the first Enlisted Career Guide Book.

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THE APPLICABILITY OF COSMOS TO THE DEVELOPMENT OF THE SUBMARINE RADIOMAN CAREER MODEL

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The thesis consists of two parts, a flow model and a data analysis section. The flow model is used to lay out the career path of an enlisted Navy radioman from accession (E-1) until the point he becomes a United States Navy Chief Petty Officer (E-7). This is the first time enlisted flows have modeled.

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EXECUTIVE SUMMARY

Maintaining a naval force that is adequate in both strength and "experience" is difficult task. Force strength is mainly driven by budgetary constraints, national military strategy and current world events (war, peace, etc.). Enlisted career managers (ECMs) attempt to evaluate changes in force strength to determine the number of personnel that will be available in the future, in order to assign the right person to the right job. The ECM must meet current and future United States Navy (Navy) requirements, by maintaining the quality of enlisted ratings and skill groups. The ECMs' ultimate goal is to match sailors' skills and experience with funded personnel requirements by the use of accessions, retention and planning of future advancement and schooling.

The purpose of this thesis is to create the framework for the development of a model that will allow ECMs to obtain immediate feedback on accession level changes that are required to obtain a specified future senior enlisted manning level.

The creation of the radioman career flow model will allow for the future implementation and development of career flow models for other rates in the Navy. Enlisted career managers will benefit by determining manning levels at different entry and exit points in the flow model. The flow model will provide the ability to determine the accession levels needed today to achieve a required number of chief petty officers in the future.

Ultimately, ECMs will be capable of determining accurate accession levels based on predictors that will determine which junior sailors have the greatest chance of promotion to CPO.

In conclusion, the Radioman Career Model represents a paradigm shift from the way the Navy formulates enlisted accessions. Current enlisted accessions are made by paygrade group billet requirements rather than by tracking individual flows. The use of this model will allow for the implementation in simulation software and the creation of the first Enlisted Career Guide Book.

The demographic variables are not good predictors for individuals' promotion to E-7. Nevertheless, according to Clementine, MAX.EDU seems to be the strongest non-demographic variable. This result is analogous to the promotion parameters used to calculate the Final Multiplication Score (FMS). In the FMS computation, education can account for up to 2% of the total score.

ACKNOWLEDGMENTS

To my wife…

You have made all of my milestones achievable.

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I. INTRODUCTION

A. BACKGROUND

Maintaining a naval force that is adequate in both strength and "experience" is difficult task. Force strength is mainly driven by budgetary constraints, national military strategy and current world events (war, peace, etc.). Enlisted career managers (ECMs) attempt to evaluate changes in force strength to determine the number of personnel that will be available in the future, in order to assign the right person to the right job. The ECM must meet current and future United States Navy (Navy) requirements, by maintaining the quality of enlisted ratings and skill groups. The ECMs' ultimate goal is to match sailors' skills and experience with funded personnel requirements by the use of accessions, retention and planning of future advancement and schooling.

This thesis is the application of the Center of Naval Analyses memorandum by David M. Rodney titled "A Community Simulation Model for Surface Warfare Officers (COSMOS) (Rodney, 1992).

B. PURPOSE

The purpose of this thesis is to create the framework for the development of a model that will allow ECMs to obtain immediate feedback on accession level changes that are required to obtain a specified future senior enlisted manning level. Figure 1 is a snapshot of current required manning levels for all radiomen paygrades by years of service. In Figure 1, FY08 EPA, (Enlisted Programmed Authorizations) represents the manning requirements that ECMs must fulfill.

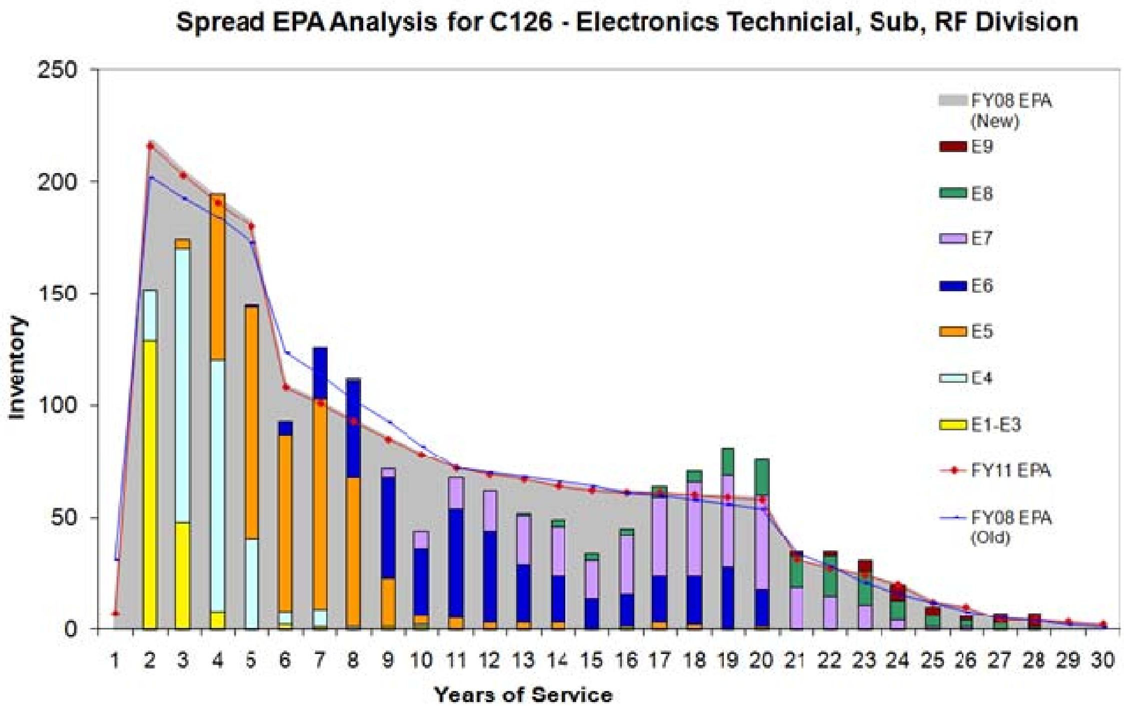

Figure 1. FY08 Enlisted Programmed Authorizations (EPA) for Submarine Radiomen

Enlisted Programmed Authorizations (EPA) provide the manpower requirements to enlisted strength planners to determine accessions, training, promotion plans and retention.

C. RADIOMAN FORCE STRUCTURE

The Unites States Navy trains personnel to operate radio room equipment in both surface ships and submarines (NAVPERS18068F, 2008). Electronics Technicians (radiomen) onboard submarines receive extensive training in the operation and maintenance of advanced electronic equipment and computers used in communications systems. Radiomen are responsible for the operation, routine care, and repair of satellite, local communications systems, computers and complex electronic and electro-mechanical equipment, Radioman are a vital element in the precise communications

connectivity of the submarine. Before their first sea assignment, submarine radiomen conduct specialty training in Groton, Connecticut. Refer to chapter 3 for a more detailed description.

The population of submarine radiomen was chosen for this study because of its simpler demographics and career paths compared to other enlisted rates in the Navy. Developing a simple working model can lead to enough insights to help make generalizations and ultimately develop a model for other enlisted rates.

Table 1illustrates the Navy Enlisted Classification Codes (NECs) that submarine radioman must obtain during their career as a submariner. These NECS are obtained during formal training and at sea. The qualification process is platform-dependent. A radioman is only required to obtain qualification for those NECs that are pertinent to the class of nuclear submarine he has been assigned to. (NAVPERS18068F, 2008)

NEC	Description
ET-14AA	Common Submarine Radio Room (CSRR) Maintenance Technician
ET-14AB	Common Submarine Radio Room (CSRR) Equipment Operator
ET-14BH	SSN 774 Class Electronic Support Equipment Maintenance Technician
ET-14CM	SSN Radio Frequency (RF) Equipment Technician
ET-14EM	SSN ESM Equipment Maintenance Technician
ET-14HH	SSN 21 Class ESM Technician
ET-14RO	SSN Radio Frequency (RF) Equipment Operator
ET-14TM	TRIDENT I/II Radio Frequency (RF) Equipment Maintenance Technician
ET-14TO	TRIDENT I/II Radio Frequency (RF) Equipment Operator
ET-14ZA	AN/BRD-7 Submarine Radio Direction Finding (RDF) Set Maintenance Technician

Table 1. Submarine Radioman NECs

D. SCOPE AND METHODOLOGY

The thesis consists of two parts, a flow model and a data analysis section. The flow model is used to lay out the career path of an enlisted Navy radioman from accession (E-1) until the point he becomes a United States Navy Chief Petty Officer (E-7). The flow model does not represent radiomen who have been promoted beyond the E-7 paygrade. Analysis beyond this point will not yield interesting insights. Submarine radioman experience very low attrition beyond the E-7 paygrade. We will assume that

once an enlisted sailor achieves an E-7 paygrade, he will stay until or past retirement. Retirement benefits occur past 20 years of service (DFAS, 2008). The majority of the thesis will be focused on the radioman career flow.

Part two of this thesis is the analysis of enlisted radioman data from October 1998 until September 2007. The data set was compiled from the Proxy Perstempo file maintained by the Defense Manpower Data Center (DMDC) containing monthly information on all active component personnel in the Navy, including name, rank and pay grade, ratings, demographics, AFQT scores categories (for enlisted personnel), expiration of term of service (ETS), and other DMDC-derived measures. A program in C language was created to filter those individuals with the radioman NECs (Navy Enlisted Classifications).

Promotion to radiomen CPOs was used as the dependent variable. The data was analyzed to determine plausible predictors for possible E-7 candidates. The intention is to determine the qualities that a junior sailor should exhibit in order to be promotable to chief petty officer (CPO).

The radioman career flow model and data analysis on this thesis will assemble the necessary insights for follow on work with simulation language implementation.

E. BENEFITS OF THE STUDY

The creation of the radioman career flow model will allow for the future implementation and development of career flow models for other rates in the Navy. Enlisted career managers will benefit by determining manning levels at different entry and exit points in the flow model. The flow model will provide the ability to determine the accession levels needed today to achieve a required number of chief petty officers in the future.

Ultimately, ECMs will be able to determine accurate accession levels based on predictors that will determine which junior sailors have the greatest chance of promotion to CPO.

F. ORGANIZATION

Chapter I provides the purpose, scope and benefits of the thesis. Chapter II describes the COMOS model. Chapter III describes the radioman career flow model. Chapter IV introduces the data used and discussion on the methodology for determining predictors for potential CPO candidates. Finally, Chapter V provides a conclusion, recommendations and potential future areas of study.

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II. COSMOS

A. INTRODUCTION

The Community Simulation Model for Surface Warfare Officers (COSMOS) models projections for United States Navy surface warfare officers (SWOs). COSMOS utilizes discrete-event simulation to model the behavior of individual officers, rather than aggregate behavior.

COSMOS was developed using two languages, General Purpose Simulation System (GPSS/H) and C language (Lawler & Lutz, 1993). The goal of COSMOS was to create an enhanced modeling capability for officer community planning capable of analyzing force management issues.

GPSS is a simulation programming language used since the early 1970's to build computer models for discrete-event simulations. GPSS/H is a newer version of GPSS. GPSS is a process-oriented language for creating simulation models. GPSS has its limitations since it requires the user be familiar with the language and requires relatively large amount of code for a significant size simulation (Schriber, 1974). Currently developed software packages minimize the use of laborious code and allow for the easy implementation of a simulation model by utilizing user-friendly graphical interfaces (i.e., Arena).

B. FUNCTIONAL REQUIREMENTS

COSMOS functional requirements were based on the requirements set forth by PERS-21. COSMOS was required to incorporate the following capabilities:

- Production of inventory projections for the conventional surface warfare officer community for up to 10 years.
    1. These inventory projections should provide information regarding length-of-service (LOS) and paygrade distributions, accessions, and strength, promotions, screening statistics and tour manning data.

- Production of projections in response to user specified policy changes (i.e., accessions, promotions, screening, authorizations, detailing and retention) (Rodney, 1992).

C. MODEL DESIGN

COSMOS models the SWO community as two processes that are interrelated. The first process considers flows of officers from one tour to another. Timing during this process depends on tour lengths rather than when the event occurs during the year. The second process takes place at specific times during the year (i.e., XO screening during third quarter of a fiscal year). These processes are connected by making promotion, screening and selection of future tours all depend on paygrade, screening and tour history.

COSMOS is a network of SWO tour flows. Each tour of duty is considered a node or process. Figure 2 and 3 illustrate 39 tours of duty simulated by COSMOS. Each SWO is assigned to a tour of duty, PCS move (in transit to next duty station) placed in a queue awaiting transfer to next duty station.

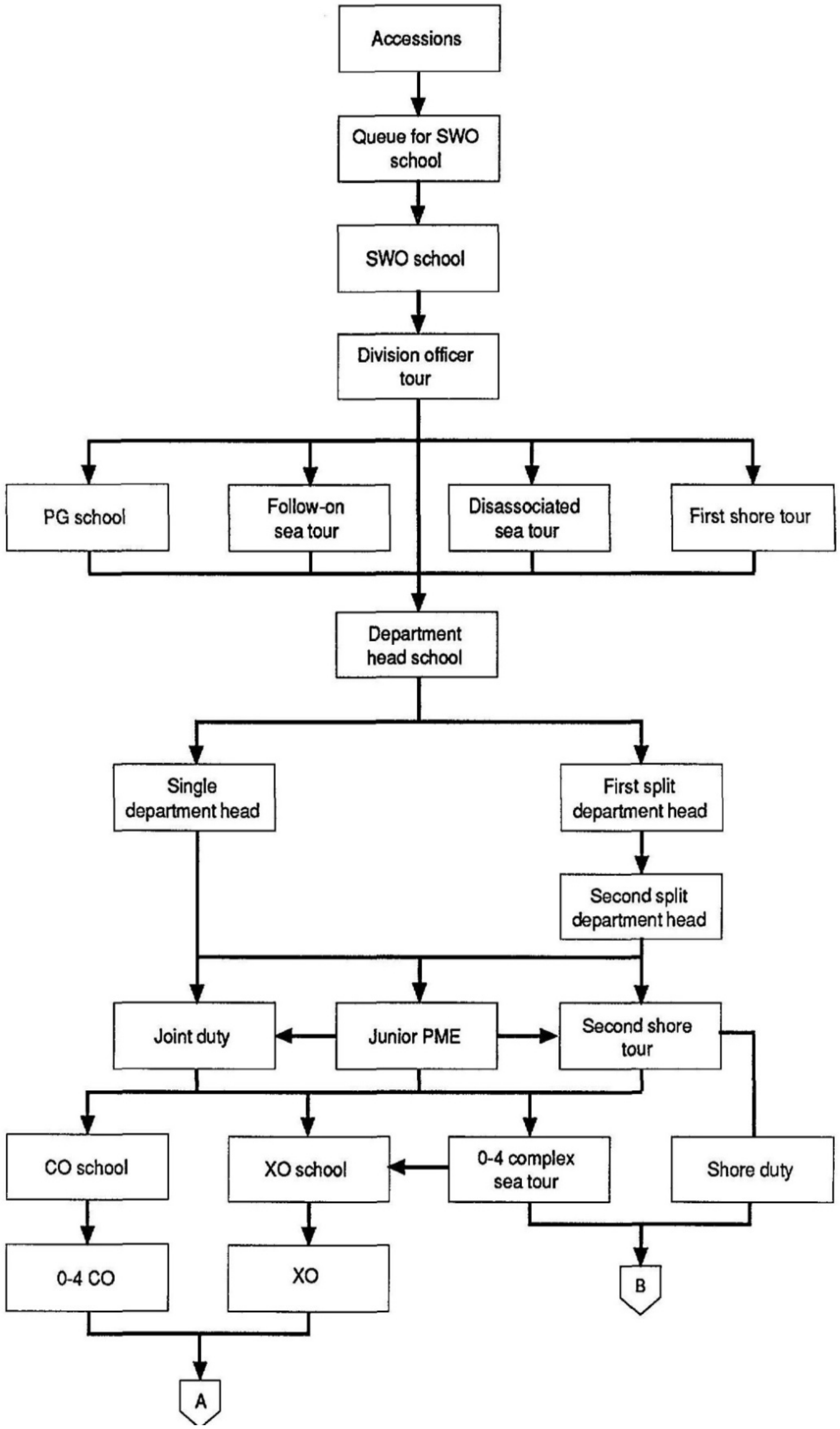

Figure 2. COSMOS Tour Flow

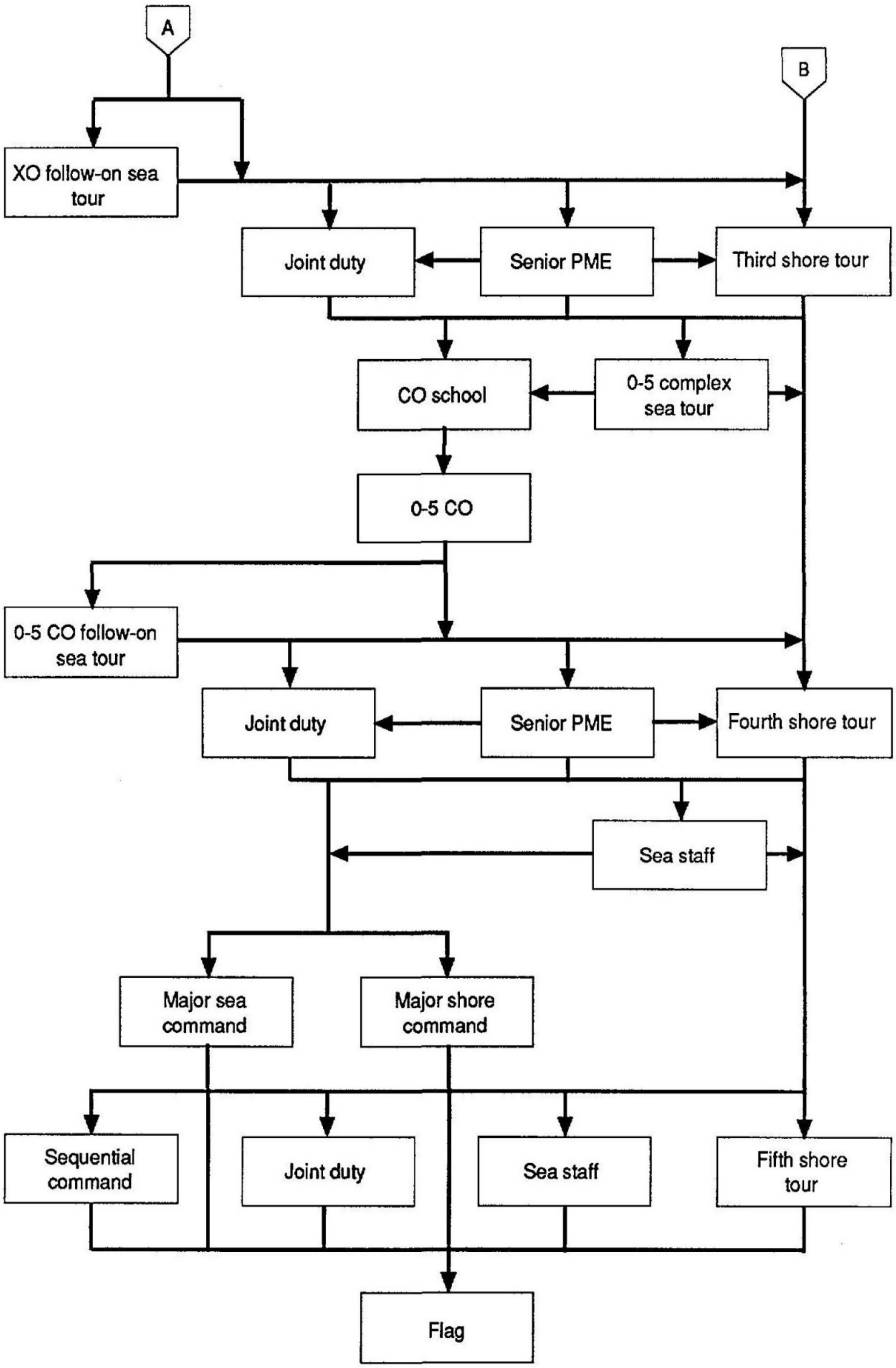

Figure 3. COSMO Tour Flow (continued)

D. COSMOS LIMITATIONS

COSMOS was developed to help officer career managers (OCMs) consider changes in SWO community end strength 10 years into the future. Validation of COSMOS produced mixed results with different projections. Projections exhibited small confidence intervals in certain areas and larger confidence intervals in others. (Rodney, 1992). Table 2 below, illustrates which COSMOS projections showed low or high variability.

Projections with <u>Low Variability</u> Between Replications	**Projections with <u>High Variability</u> Between Replications**
Endstrength	Accessions
Short-term projections	Long-term projections
Manning of high priority billets with precise number of vacancies	Manning of low priority billets without a precise number of vacancies
Sea and shore manning	Promotions and screening (not all paygrades)

Table 2. COSMOS Projections Variability (source: Rodney, 1992)

Some of the forecasted inaccuracies occur as a result of inaccuracies in initial inventory. The stochastic nature of the COSMOS projections leads to projections that have narrow confidence intervals in short-term projections and larger error in the long term. Tightly constrained projections (i.e., endstrength) are almost deterministic in nature and hence resulted with a low variability.

COSMOS' main strength is the ability to provide broad projections of future SWO behavior that encompasses all major characteristics of SWO community development (i.e., promotion rates, year group size, billeting, etc). COSMOS' capability of providing accurate short-term projections for policy execution and budget planning should be considered secondary (Rodney, 1992).

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III. RADIOMAN CAREER FLOW MODEL

A. INTRODUCTION

The radioman career model is used to project radioman endstrength by paygrade and LOS. The radioman career model is the first step in the creation of the rate-dependent career handbook.

B. FUNCTIONAL REQUIREMENTS

The radioman career flow model was developed to meet the tracking requirements of BUPERS 323, PERS-811 and N1J3. The desired output is radioman end strength by paygrade.

C. MODEL DESIGN

The Radioman Career Model consists of five network flows that interact with one other to track the progression of the individual from accession until promotion to E-7. The model tracks career progression by keeping record of most current paygrade promotion, NEC history and length of service (LOS). Paygrade, NEC history and LOS are used to determine the individual's eligibility for billets and promotions. Figure 4 is the Radioman Model Flow. Every individual "flowing" through the pipeline is considered an entity. The Model Flow network shows the main network flow from accession until the promotion to E-7, where each block (accession, A-School, etc) is a node. All other networks (Figure 5 through Figure 8) are a more detailed version of what happens on each node.

Every time an entity "flows" through a node the state variables of paygrade, NEC and LOS are updated. APPENDIX A, "Processes," contains detailed information on each node.

1. Radioman Model Flow

The accession node includes the time from Recruiting Training Command (RTC) until the radioman enters the queue awaiting A-School. Before a radioman can start A-School he must satisfactorily complete RTC training, Basic Enlisted Submarine School (BESS), Apprenticeship Technical Training (ATT) and Technical Computer Network Operator (TCNO). All other submarine non-nuclear rates must go through RTC and BESS. Of all submarine non-nuclear rates that undergo RTC and BESS, only sonarman (STS), ET-Navigation (ETNO), radioman (ETRO) and firecontrol technicians (FT) must complete ATT and TCNO schools. The STS, ETNO, ETRO and FT group is known as SECF. The attrition rates in these schools are negligible compared with those from the radioman A-School (ETRO "A"). Attrition rates for ETRO "A" (12.04% for 2005, Table 4) are two times larger than attrition obtained from BESS (5.93%, Table 3). More losses occur in A-School than during other previous schools. For this reason these four training milestones' attritions are captured by using the "Accession" and "Queue for A-School" nodes. Table 3 and Table 4 show overall attrition rates from 2005 until present.

BESS Historical Attrition Rates

	BESS(All Rates)	BESS (SECF)
2005	7.19%	5.93%
2006	4.04%	3.25%
2007	5.70%	4.48%
2008	7.44%	4.40%
Mean	6.09%	4.51%
Median	6.44%	4.44%
Standard Deviation	0.01569	0.01101
Confidence Level(95.0%)	2.50%	1.75%

Table 3. Basic Enlisted Submarine School Attrition Rates

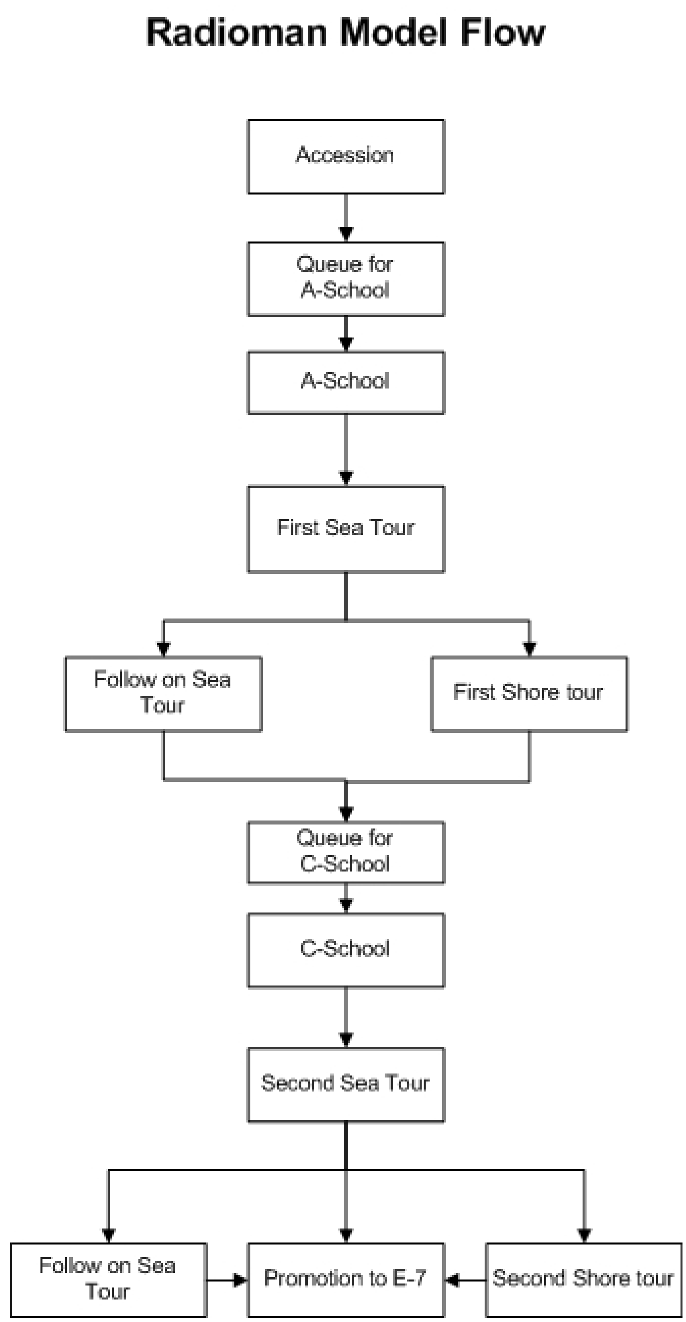

Figure 4. Radioman Model Flow

SECF Historical Attition Rates

	SECF					
	ATT(CDP 986A)	TCNO	ETRO "A"	ETNO "A"	FT "A"	STS "A"
2005	2.66%	N/A	12.04%	N/A	3.33%	4.08%
2006	3.96%	2.24%	9.90%	10.18%	13.23%	12.88%
2007	1.94%	2.37%	15.89%	7.56%	10.27%	11.54%
2008	2.91%	2.75%	10.64%	9.78%	9.28%	10.32%
Mean	2.87%	2.45%	12.12%	9.17%	9.03%	9.71%
Median	2.79%	2.37%	11.34%	9.78%	9.77%	10.93%
Standard Deviation	0.00835	0.00264	0.02667	0.01415	0.04151	0.03893
Confidence Level(95.0%)	1.33%	0.66%	4.24%	3.52%	6.60%	6.19%

Table 4. Submarine Electronics Computer Field (SECF) Attrition Rates

Upon completion of A-School, radiomen transfer to their first sea tour. During their first sea tour, radioman will conduct further training and qualifications preparing them for their next job as division leading petty officer. Division leading petty officer billets are available for radioman on their second sea tour, with the required NECs. After a successful sea tour a radioman will have the option for a follow-on sea or shore tour. If a radioman prefers a “fast track” to an E-7 promotion a follow-on sea tour is preferred. During follow-on sea tours sailors sharpen their skill and gain NECs before their shipmates on shore tour. In general shore tours are non-rate specific, which means that a sailor may require additional time after the shore tour to regain the level of training and proficiency.

After a follow-on sea tour or first shore tour, radiomen are sent to C-School. In C-School radioman acquire NECs to conduct maintenance on advanced equipment junior sailors cannot repair. After C-School training, radioman will head to their second sea tour to complete qualifications required to become selection board eligible (SBE) for E-7. Their second shore tour is similar to their first shore tour, since most likely no NECs will be earned. Most radioman will be promoted for CPO before they transfer to their next command, either sea- or shore-based.

The following sections describe the remaining flows in more detail: A-School training, selection after A-School training, C-School training and selection after C-School training.

2. Radioman A-School Training Flow

Radioman A-School Flow, illustrates the options and entity flow during A-School training. As mentioned before the "Accession" and "Queue for A-School" nodes include the attrition rates of all training prior to A-School. Once the student enters the process "Queue for A-School" he is waiting "in line" to start in a new A-School class. A-School classes overlap and convene up to ten times a year. Each process has a length of 215 days. This calculation is an estimate based on the actual instruction time of 142 business days.

A student will commence class only if he is not on hold and seats are available. Holds that occur in A-School affect overall student flow. These hold can be categorized as administrative (Admin), medical and legal holds. An Admin hold might be due to poor academic performance. Medical holds occur when the student is unable to attend school for medical reasons. Legal holds are due to security clearance issues, misconduct, etc.

If the student is on hold he will be placed in a "Hold Queue." Once the hold is released, the student will be removed from the "Hold Queue" and placed either on the "Queue for A-School" or the "A-School" process. If a student is placed back on the A-School process he will be assigned to one of the "A-School" processes currently in progress. Retuning to an "A-School" process is possible since "time in training" was recorded and stored before the student was placed on the "Hold Queue."

Students who are academically disenrolled and are placed on hold, exit the system and are considered a loss. The model considers a candidate a loss when he cannot be promoted to radioman CPO.

Upon completion of A-School, LOS, paygrade and NECs are updated. Parameters saved during this process are LOS, paygrade, NECs, and training time.

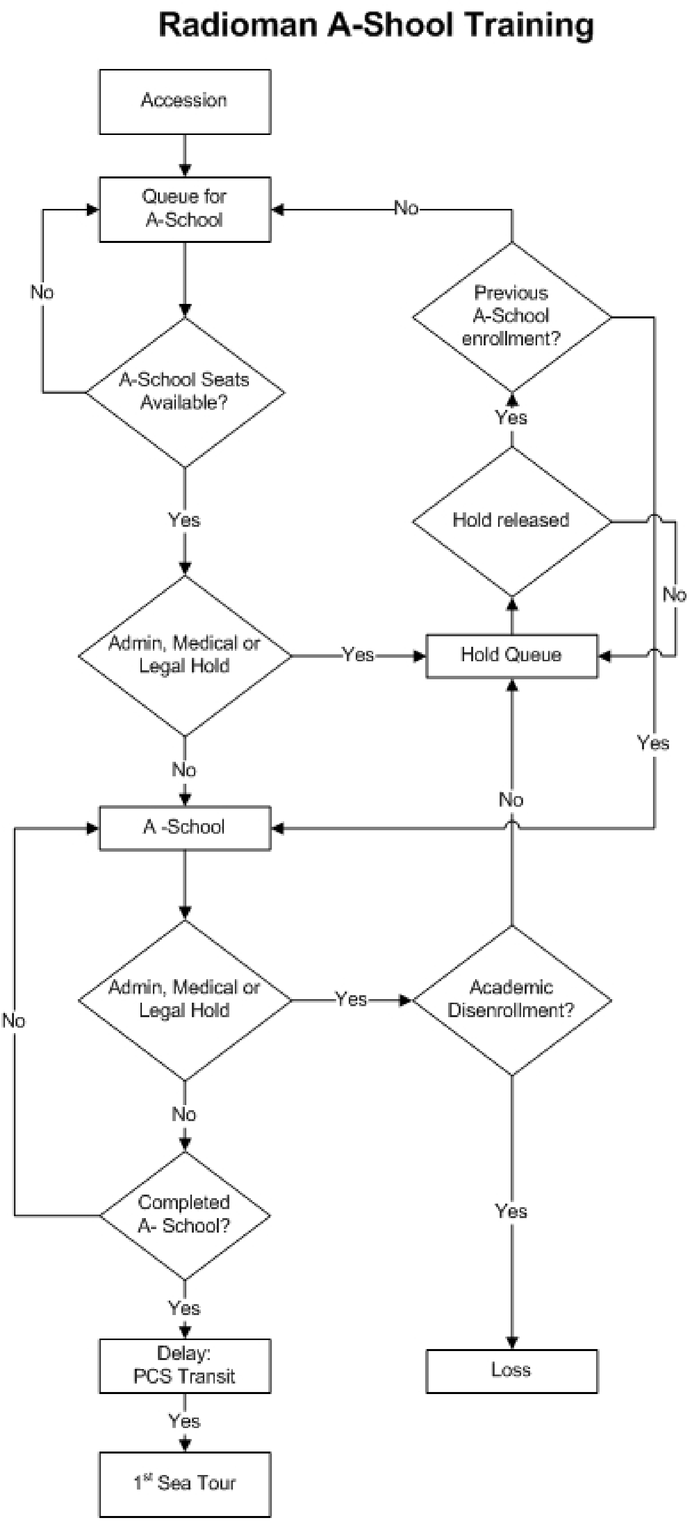

Figure 5. Radioman A-School Flow

3. Radioman Selection Post A-School Training

Radioman Selection Post A-School Training, illustrates the options and flow post A-School training. Once a radioman completes A-School he transfers to a sea command starting his first sea tour. A sea tour is complete when required NECs are obtained and re-enlistment has occurred. The radioman will either choose a follow-on sea tour or a shore tour.

A small amount of radioman E-4s may be selected for C-School training. These radiomen will be advanced to C-School because of their above average performance. Early C-School occurs approximately after 3 years at sea. After C-School graduation students will be assigned to sea duty.

When follow-on sea or shore tour billets are not available the individual is sent back to the “First Shore Tour” process and given priority in queue for the next billet availability. Individuals who complete shore or sea tours are sent to the “Queue for C-School”.

Loses are considered at the beginning of the process. A loss is defined in this section as those individuals who failed to reenlist before their shore or follow-on sea tour.

Upon completion of post A-School flow, LOS, paygrade and NECs are updated. Parameters saved during this process are: LOS, paygrade and NECs.

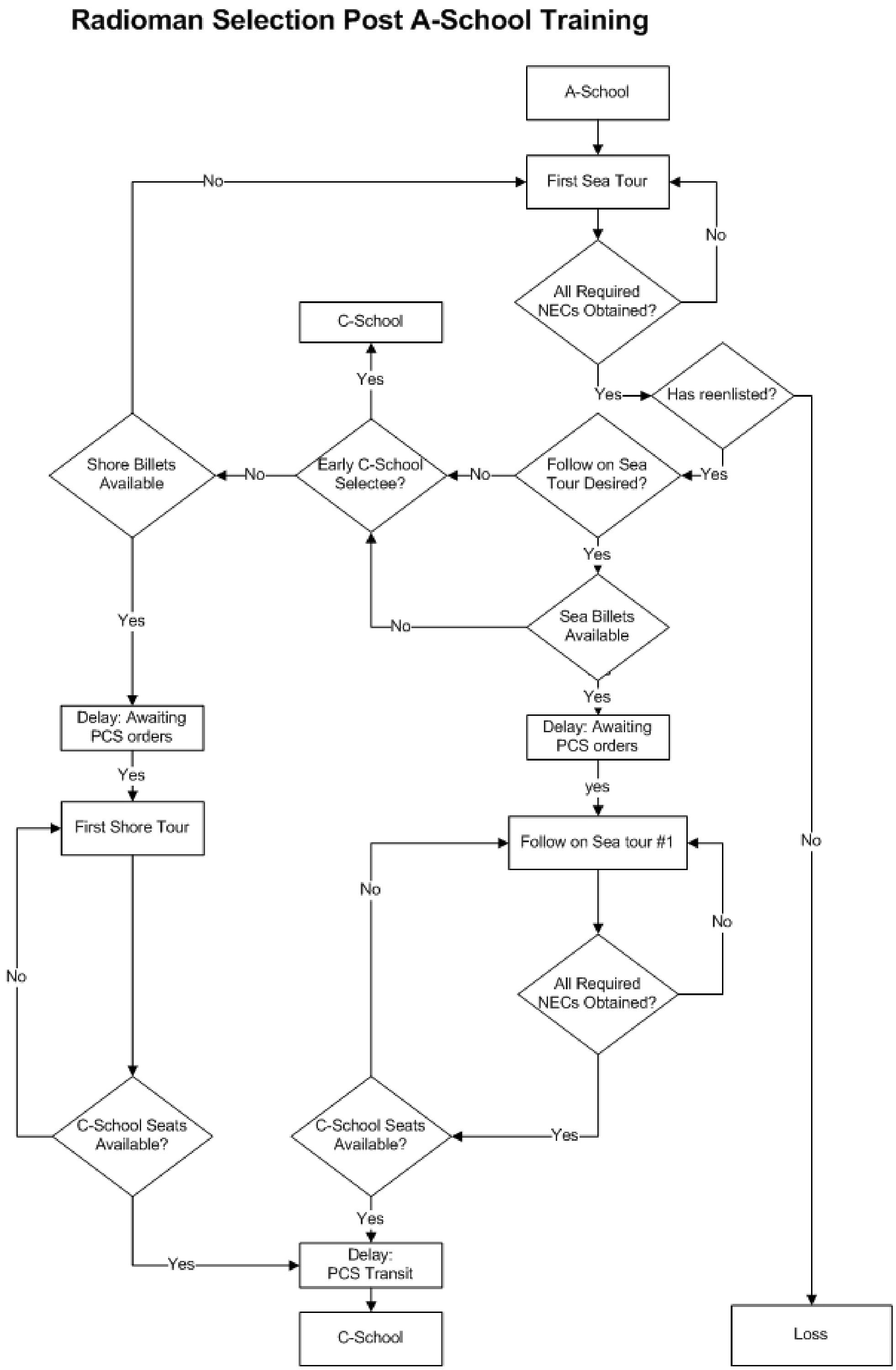

Figure 6. Radioman Selection Post A-School Training

4. Radioman C-School Training Flow

Radioman C-School Flow, illustrates the options and flow during C-School training. Radioman flow from follow-on sea or first shore tour to "Queue for C-School." This flow model follows the same characteristics as the A-School flow Model (Figure 5).

Once the student is awaiting A-School, he will commence class only if he is not in hold and seats are available. Holds that occur in C-School affect overall student flow. Holds are categorized as administrative (Admin), medical and legal holds. An Admin hold might be due to poor academic performance. Medical holds occur when the student is unable to attend school due to medical reasons. Legal holds can be due to security clearance issues, misconduct, etc.

Students on hold will be placed in a "Hold Queue." Once the hold is released, the student will be removed from the "Hold Queue" and placed either on the "Queue for C-School" or the "C-School" process. If a student is placed back on the C-School process he will be assigned to one of the "C-School" processes currently in progress. Retuning to "C-School" process is possible since "time in training" was recorded and stored before the student was placed on the "Hold Queue."

As the A-School model, students who are academically disenrolled and are placed on hold, exit the system and are considered a loss. The model considers a loss, a candidate that cannot be promoted to radioman CPO.

Upon completion of C-School, LOS, paygrade and NECs are updated. Parameters saved during this process are LOS, paygrade, NECs, and training time.

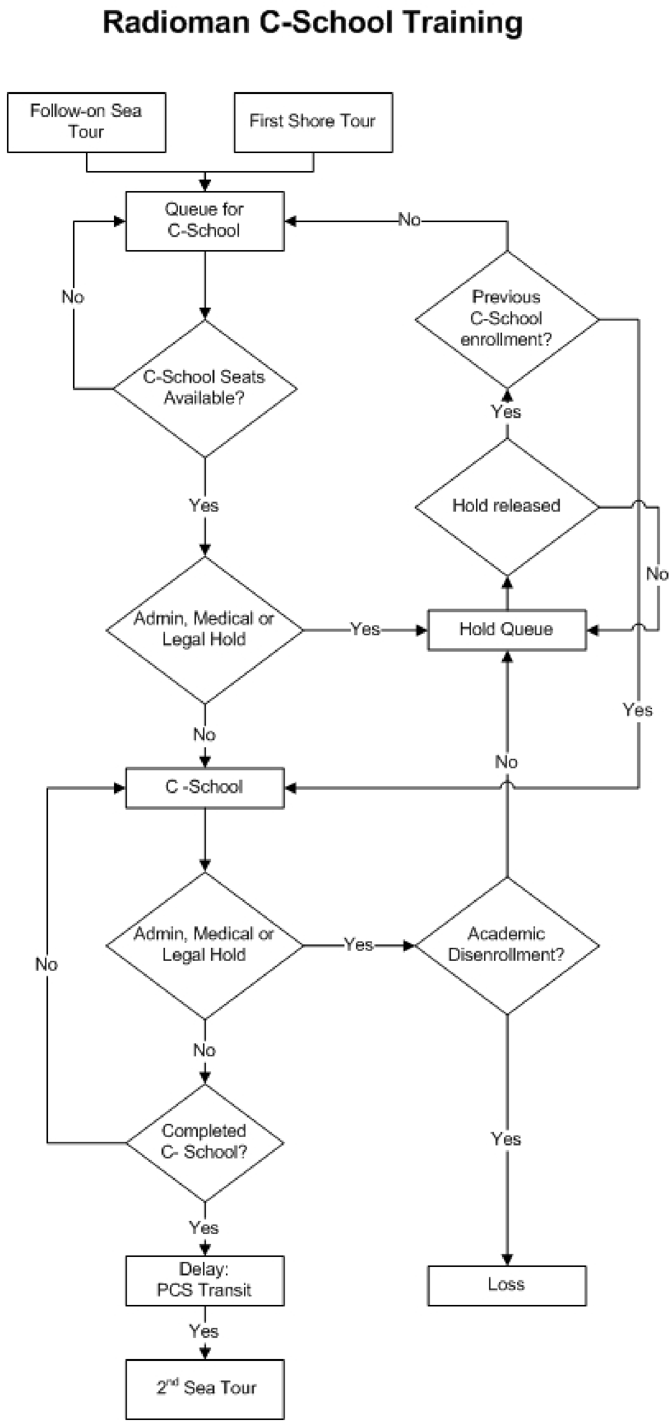

Figure 7. Radioman C-School Flow

5. Radioman Selection Post C-School Training

Radioman Selection Post C-School Training, illustrates the options and flow post C-School training. Radioman flow from C-School to their last at sea tour before an E-7 promotion.

In this flow model every entity exits the system as a success or failure. A success occurs when the individual is promoted to E-7 in the allotted time. Failures are those entities that enter “Loss” or “Delayed E-7 Promotion”. A “Loss” is considered at the beginning of the process for radioman who for one reason or another decided not to reenlist. “Delayed E-7 Promotion” is considered a failure since radioman weren’t selected to an E-7 promotion before their next sea tour, consequently unable to fulfill a leading Chief Petty Officer billet on their next sea tour. Promotion to E-7 could occur while at sea or during their next shore tour.

Upon completion of post C-School flow, LOS, paygrade and NECs are updated. Parameters saved during this process are LOS, paygrade and NECs.

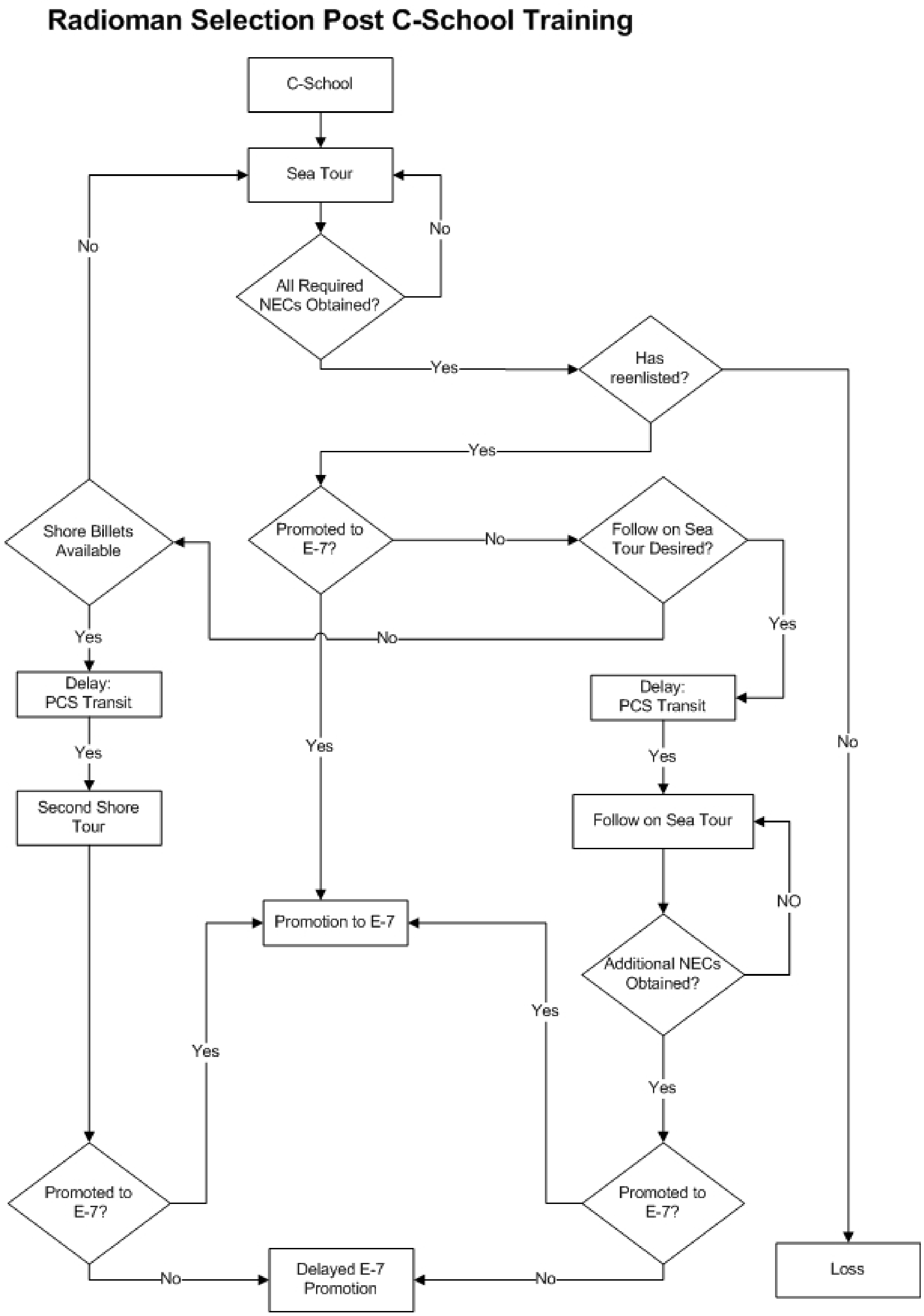

Figure 8. Radioman Selection Post C-School Training

D. OTHER CONSTRAINTS

1. Promotion

This models tracks promotion as a function of LOS and NECs. Promotions are vacancy driven. Radiomen, E-1 through E-6, are promoted in the United States Navy based on:

a. Command Evaluations

Command evaluations are used for promotion purposes when the individual is compared with their peer. This is accomplished by a “break out” comparison with the reporting senior’s average.

b. Promotion Recommendations

The individual’s promotion recommendation history is evaluated for consistency, improvements and degradation. Candidates are evaluated as well as their relationship amongst their peers.

c. Description of Duties

Previous duties are evaluated for job scope, leadership, level of responsibility, etc.

d. Professional Maturity and Experience

Professional maturity and experience is measured by history of assignments (sea and shore duty rotations), duty diversity, out of rate of assignments.

A CPO candidate is evaluated using the above in addition to the E-7 exam test score. APPENDIX B, "Final Multiple Computation”, shows how the final multiple score (FMS) is obtained for promotion purposes..

2. Tour Capacities

After the completion of a tour, a radioman can receive orders to shore duty or transfer to follow-on sea tour. A follow-on sea tour is appealing for sailors who desire advanced qualifications and fast promotion to E-7. Before an E-7 promotion a radioman will have at least two completed sea tours.

APPENDIX A, "Processes," contains data pertinent to current A-School and C-School manning limitations. Sea and shore tour capacities and attrition are arbitrary and can change every year.

3. Analysis of Policy Changes

Policy changes can be implemented by changing manning requirements and flow capacities.

4. Time-Dependent Modeling

Accessions and promotions occur at regular intervals. Accessions occur twice a year. Promotions occur at multiple times during the year (Table 5). Table 5 shows frequency of promotions.

Promotion dates

Caditate	Date	Month
CPO	3rd Thursday	January
E-6	1st Thursday	March and September
E-5	2nd Thursday	March and September
E-4	3rd Thursday	March and September

Table 5. Enlisted Promotion Dates

Time-dependent events require time-keeping to track how much time have elapsed since the start of the simulation.

5. Accessions

The user can manually input accessions to model policy changes, EPA requirements or historical rates. APPENDIX C, "EPA Spread Calculator”, can be used to calculate and compare actual and forecasted EPAs.

6. Radioman Losses

The model considers a loss as those individuals who lose eligibility for promotion to E-7. Losses are collected by the “Loss” process on all flows.

E. MODEL POTENTIAL WEAKNESSES

1. The model does not take into account individuals who enter the system due to rating mergers or rating transfers.

2. Reenlistments are based on historical rates summarized only at the beginning of each flow model. The model does not account for billets taken by those getting out of the system.

3. A lack of shore or sea tour billets returns the individual back to the system instead of directed him to a separate queue.

4. The model assumes only one class of submarine. Each class of submarine has a different radio room and required qualifications.

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IV. DATA ANALYSIS

A. INTRODUCTION

This chapter reviews the data and provides results from the analysis of enlisted radioman data from October 1998 until September 2007. The data set was compiled from the Personnel Tempo Project Active Duty Personnel Cohort File (Proxy_Perstempo) maintained by the Defense Manpower Data Center (DMDC). Proxy_Perstempo contains 120 months of data for all Navy active personnel. The data recorded includes name, rank and pay grade, ratings, demographics, AFQT scores categories, expiration of term of service (ETS), and other DMDC-derived measures. APPENDIX E, “DMDC DATA FIELDS”, lists and explains the fields used in this study. A program in C language was created to filter those individuals with the radioman NECs. The data was analyzed to determine plausible predictors for possible E-7 candidates.

B. DATA

The original data contains filtered navy enlisted personnel with an NEC starting with the number fourteen (8,126 records). NEC achievement was recorded monthly, for a total of 120 months. Radioman NECs were filtered resulting in a table with 3,561 records and 120 columns. Each column represents a month in the radioman’s career.

Another table was created containing all enlisted individuals who were promoted to E-7. The resulting table contained 1,821 records. In order to determine which of those 1,821 records corresponded to radiomen, NEC’s from those records were compared with a known set of NECs. From the complete E-7 population (1,821 records), 829 individuals who achieved E-7 promotion had at least one NEC and 460 had a combination of NEC’s required for a radioman. The 829 records are comprised of radioman E-7s as well as some who may have transferred to another rate.

NEC Combinations	Total	E-7 Promoted	% Promoted
ET-14RO ET-14CM	355	147	41.41%
ET-14TO ET-14TM	107	26	24.30%
ET-14 EM ET-14HH ET14-BH	791	322	40.71%
ET-14RO ET-14CM ET-14 EM ET-14HH ET14-BH	40	29	72.50%
ET-14TO ET-14TM ET-14 EM ET-14HH ET14-BH	11	4	36.36%
ET-14RO ET-14CM ET-14TO ET-14TM	6	2	33.33%
NEC Combinations without repeated SSNs	1183	460	38.88%

Table 6. NEC Combinations

The data set was divided in two sets: a radioman population, with 3,531 records ("Population") and a radioman CPO promotable set, with 1,183 records ("Promotable"). Each set was compared with the 460 records of the radioman E-7 set ("CPO") to create the model. "CPO" was created by merging the NEC combinations in Table 6 and determining which of those individuals were promoted to E-7. "Population" contains all radiomen who have obtained at least one NEC. "Promotable" contains those individuals that have at least one of the NEC combinations listed on Table 6.

Clementine Software (from SPSS Inc.) was used to partition the data into two training and test sets. Partitioning the data allowed the software to "train" the model with one sample and "test" with the other. The partitions were analyzed using logistic regression, neural networks and classification and regression (C&R) Tree. Descriptions of the variables analyzed are listed in Table 7.

Variable	Description
DOBYY	Date of Birth -Year
PEBDYY	PER Pay Entry Base Date (Year)
PEBDMM	PER Pay Entry Base Date (Month)
DOLEYY	Date of Latest Enlistment (Year)
Marital	Enlisted MEPCOM Marital/Family Status
AFQTCat	Enlisted MEPCOM AFQT Category (1980 Metric)
NewRace	New Race Coding (added April 2006)
MAX.EDU	Highest Degree Achieved (Compiled by the Author)

Table 7. Date Field Description

Logistic regression is a statistical technique for classifying records on values with categorical input fields. A neural network is analogous to a nervous system, where the basic units are neurons, and are organized in layers. Neural network analysis is used to create and train a neural network. Finally, the C&R tree analysis is a tree-based classification and prediction method, which utilizes recursive partitioning to split the training records into segments. (SPSS, 2007)

The research was limited to the information available from the DMDC database.

C. RESULTS FOR "PROMOTABLE"

Below are the results of the three analysis methods used. The neural network model is the most accurate, since the value predicted by the model matched the actual response for 586 records out of 798 (73.43%).

1. Neural Network Model

The neural network model comparison between the test and training set are shown on Table 8. The test set error rate is very close to the training set's. According to this model, Clementine claims that the variable year of latest enlistment (DOLEYY) is important. This conclusion is expected, since radiomen in this data set belong to the same cohort and reenlistments after the second sea tour corresponds to individuals staying in the Navy until retirement. Figure 9 shows the significant variables in the analysis. The most significant non-demographic variable is maximum education achieved (MAX.EDU). However, Clementine lists MAX.EDU as the third most important variable, followed by AFQTCat as fifth.

Neural Network				
	Training Set		Test Set	
Correct	297	77.14%	586	73.43%
Wrong	88	22.86%	212	26.57%
Total	385		798	

Table 8. Neural Network Comparison between Test and Training for "Promotable"

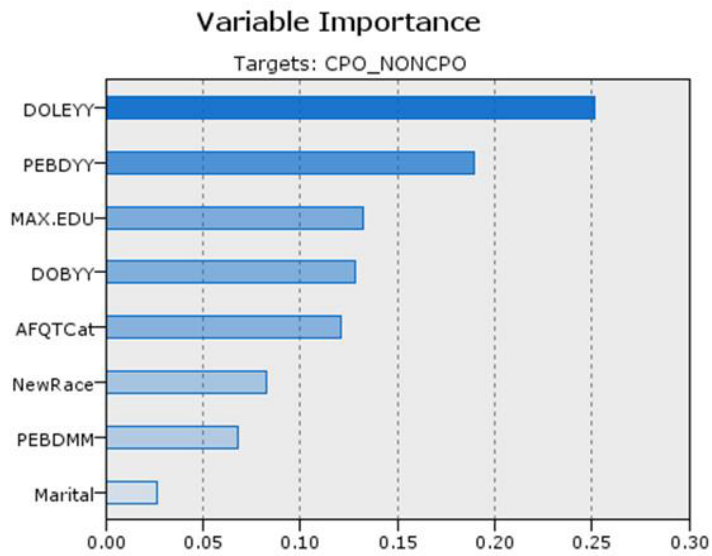

Figure 9. Neural Network Variable Importance for "Promotable"

2. Logistic Regression Model

The value predicted by the model matched the actual response for 571 records out of 798 (71.55%). Table 9 summarizes the model results obtained from the test and training set. APPENDIX G, "Promotable Set Regression Results Detail" contains the advanced regression output from Clementine. This model is rejected, since the test set accuracy is lower than in the neutral network.

Logistic Regression				
	Training Set		Test Set	
Correct	306	79.48%	571	71.55%
Wrong	79	20.52%	227	28.45%
Total	385		798	

Table 9. Logistic Regression Comparison between Test and Training for "Promotable"

3. C&R Tree Model

The C&R model comparison between the test and training set are shown on Table 10. The value predicted by the model matched the actual response for 559 records out of 798 (70.05%). According to this model Clementine claims that the variable year of latest enlistment (DOLEYY) and pay entry base month (PEBDMM) are important. Again, just like the neural network model, the radiomen in this data set belong to the same cohort and reenlistments after the second sea tour correspond to individuals staying in the Navy until retirement. Figure 10 shows the significant variables in the analysis. Clementine lists MAX.EDU as the least important variable. The prediction accuracy on the test set is lower than the accuracy on the other two models; therefore this model is rejected.

Tree Network				
	Training Set		Test Set	
Correct	311	80.78%	559	70.05%
Wrong	74	19.22%	239	29.95%
Total	385		798	

Table 10. C&R Tree Network Comparison between Test and Training for "Promotable"

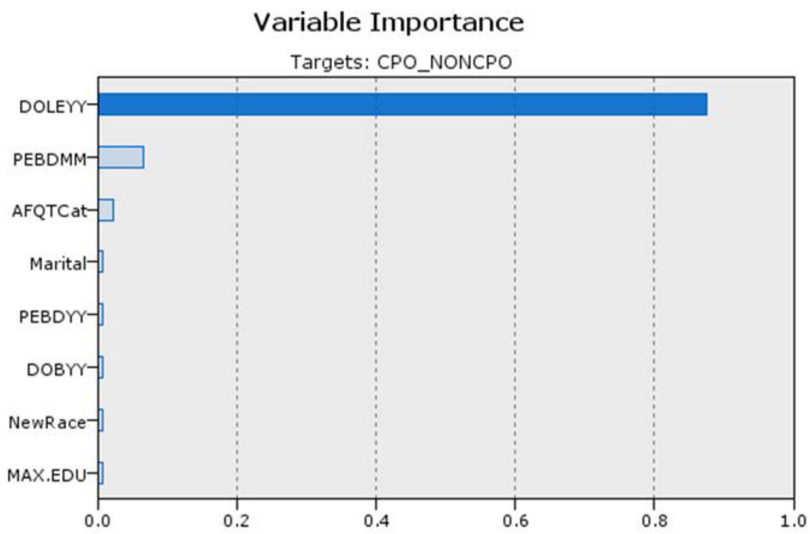

Figure 10. C&R Tree Model Variable Importance for "Promotable"

D. RESULTS FOR "POPULATION"

Below are the results of the three analysis methods used. The neural network model is more accurate, since the value predicted by the model matched the actual response for 2,041 records out of 2,333 (87.48%).

1. Neural Network Model

The neural network model comparison between the test and training set are shown on Table 11. The test set error rate is very close to the training set's. According to this model, Clementine claims that variables DOLEYY, MAX.EDU and PEBDMM are the most important. Figure 11, shows the significant variables of the analysis. Clementine lists MAX.EDU as the second most important variable.

Neural Network				
	Training Set		Test Set	
Correct	1,030	85.98%	2,041	87.48%
Wrong	168	14.02%	292	12.52%
Total	1,198		2,333	

Table 11. Neural Network Comparison between Test and Training for "Population"

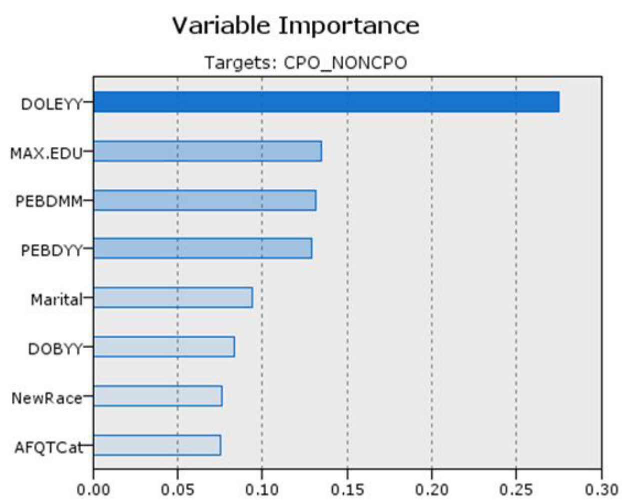

Figure 11. Neural Network Variable Importance for "Population"

2. Logistic Regression Model

The logistical regression model's comparison results between test and training set are shown on Table 12. The value predicted matched the actual response for 2,022 records out of 2,333 (86.67%). APPENDIX H, "ALL RM Set Regression Results Detail", contains the advanced regression output from Clementine.

Logistic Regression				
	Training Set		Test Set	
Correct	1,025	85.56%	2,022	86.67%
Wrong	173	14.44%	311	13.33%
Total	1,198		2,333	

Table 12. Logistic Regression Comparison between Test and Training for "Population"

3. C&R Tree Model

The C&R model's comparison results between test and training set are shown on Table 13. The value predicted matched the actual response for 1,981 records out of 2,333 (84.91%). Clementine claims that the pay entry base year (PEBDYY) is the most important. Figure 12, shows the significant variables in the analysis.

Tree Network				
	Training Set		Test Set	
Correct	1,039	86.73%	1,981	84.91%
Wrong	159	13.27%	352	15.09%
Total	1,198		2,333	

Table 13. C&R Tree Model Comparison Between Test and Training for "Population"

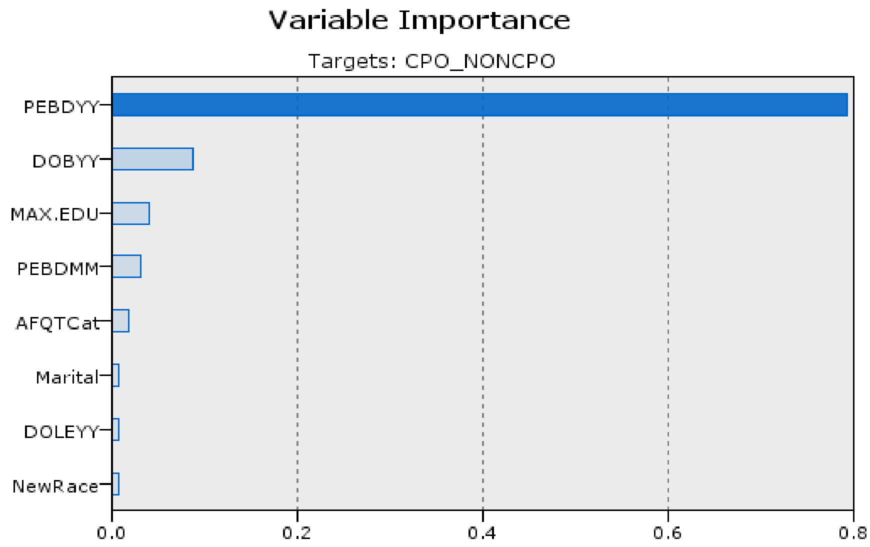

Figure 12. C&R Tree Node Variable Importance for "Population"

E. INTERPRETATION OF RESULTS

"Promotable" and "Population" could be modeled using the neural network model. Based on Clementine's list of variable importance (Table 8 on page 31) DOLEYY, PEBDYY and MAX.EDU are important variables. The importance of DOLEYY and PEBDYY could be explained because the set contains radioman data from approximately ten years (1998 through 2007), and the radioman population belongs to the same cohort; therefore sharing the Year of Latest Enlistment and Pay Entry Base Year. The importance of MAX.EDU could be related to the Final Multiple Calculation (FMC). The FMC calculates the Final Multiple Score (FMS). The FMS is a weighted computation of enlisted "factors" taken into consideration for promotion. MAX.EDU accounts for up to 2% of the FMS (BUPERS1430.16F, 2007).

V. CONCLUSION

A. INTRODUCTION

This thesis creates the framework for the development of a model that will allow ECMs to obtain immediate feedback on accession level changes that are required to obtain a specified future senior enlisted manning level. This is the first time enlisted flows have modeled. One possible reason is that enlisted billeting is conducted by paygrade group rather than individual tracking. The resources herein will allow the programmer to implement the Radioman Career Model with simulation software.

B. RECOMMENDATIONS FOR AREAS OF FUTURE STUDY

The following are recommended areas of future study, which while useful are beyond the scope of this study:

1. Implement the Radiomen Career Model with simulation software.
2. Determine the effects of adding enlisted exam score data to E-7 demographics and promotion and the calculated time in service per paygrade. Service time in paygrade attributes up to 7% toward the Final Multiple Score (FMS). See APPENDIX B, “Final Multiple Computation” for more details.

C. CONCLUSIONS

The Radioman Career Model represents a paradigm shift from the way the Navy formulates enlisted accessions. Current enlisted accessions are made by paygrade group billet requirements rather than by tracking individual flows. The use of this model will allow for the implementation in simulation software and the creation of the first Enlisted Career Guide Book.

We can conclude that demographic variables are not good predictor for individuals promotable to E-7. Nevertheless, according to Clementine, MAX.EDU seems to be the strongest non-demographic variable. This result is analogous to the promotion parameters used to calculate the Final Multiplication Score (FMS) (BUPERS1430.16F, 2007). In the FMS computation, education can account for up to 2% of the total score.

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APPENDIX A PROCESSES

A-School Flow

Node i	Node j	Attrition	Capacity	NEC gained	Paygrade	Duration (Businness Days)	notes
Accession	Queue A-School	-	-	-	E1	169	-
Queue A-School	Hold Queue	-	24 /class	-	E1	-	240 total/year
Queue A-School	A-School	-	24 /class	-	E2	-	240 total/year
Hold Queue	Queue A-School	-	24 /class	-	E2	-	240 total/year
Hold Queue	A-School	-	24 /class	-	E2	-	240 total/year
A-School	Loss	-	24 /class	-	E2	-	240 total/year
A-School	Sea tour	-	24 /class	14RO / 14TO/14AB	E2/E3	142	240 total/year

Selection Post A-School

Node i	Node j	Attrition	Capacity	NEC gained	Paygrade	Duration (Businness Days)	notes
A-School	Sea tour	-	-	-	E2/E3	30	-
Sea tour	Shore Tour	-	-	14BH/14EM/14HH	E4/E5/E6	1825	-
Sea tour	Follow on tour	-	-	-	E4/E5/E6	1825	-
Sea tour	Loss	-	-	-	-	-	-
Shore Tour	C-School	-	-	-	E4/E5/E6	1095	-
Follow on tour	C-School	-	-	-	E4/E5/E6	1095	-

C-School Flow

Node i	Node j	Attrition	Capacity	NEC gained	Paygrade	Duration (Businness Days)	notes
Sea/Shore Tour	Queue C-School	-	-	-	E4/E5/E6	30	-
Queue C-School	Hold Queue	-	12 /class	-	E4/E5/E6	-	60 total/year
Queue C-School	C-School	-	12 /class	-	E4/E5/E6	-	60 total/year
Hold Queue	Queue C-School	-	12 /class	-	E4/E5/E6	-	60 total/year
Hold Queue	C-School	-	12 /class	-	E4/E5/E6	-	60 total/year
C-School	Loss	-	12 /class	-	-	-	60 total/year
C-School	Sea tour	-	12 /class	14CM/14TM/14ZA14/AA	E5/E6	75	60 total/year

Selection Post C-School

Node i	Node j	Attrition	Capacity	NEC gained	Paygrade	Duration (Businness Days)	notes
C-School	Sea tour	-	-	-	E5/E6	30	-
Sea tour	E-7 Promotion	-	-	-	E7	-	-
Sea tour	Follow on Sea	-	-	-	E6	1825	-
Sea tour	Shore tour	-	-	-	E6	1825	-
Sea tour	Loss	-	-	-	-	-	-
Shore Tour	E-7 Promotion	-	-	-	E7	1095	-
Shore Tour	Delayed E-7	-	-	-	E7	1095	-
Follow on tour	E-7 Promotion	-	-	-	E7	-	-
Follow on tour	Delayed E-7	-	-	-	E7	-	-

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APPENDIX B FINAL MULTIPLE COMPUTATION

Exam		Computation	Maximum Points and %		
FACTOR	PAYGRADE		E-4/5	E-6	E-7
Performance	E-4/5	(PMA X 80) - 230	90 (42%)	116 (47.5%)	80 (50%)
	E-6	(PMA X 80) - 204			
	E7	(PMA X 50) - 120			
Standard Score	ALL	Indicated on Exam Profile Sheet	80 (37%)	80 (33%)	80 (50%)
Service in Paygrade	E-4/5	(2 X SIPG) + 7.5	15 (7%)	17 (7%)	
	E-6	(2 X SIPG) + 9.5			
PNA Points	E-4/5/6	PNA Points from last 5 cycles	15 (7%)	15 (6%)	
Education	E-4/5	2 AA or 4 BA/BS	4 (2%)	4 (1.5%)	
Awards	E-4/5/6	Values in Adv Manual	10 (5%)	12 (5%)	
Maximum FMS Points Possible			214	244	160

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APPENDIX C EPA SPREAD CALCULATOR

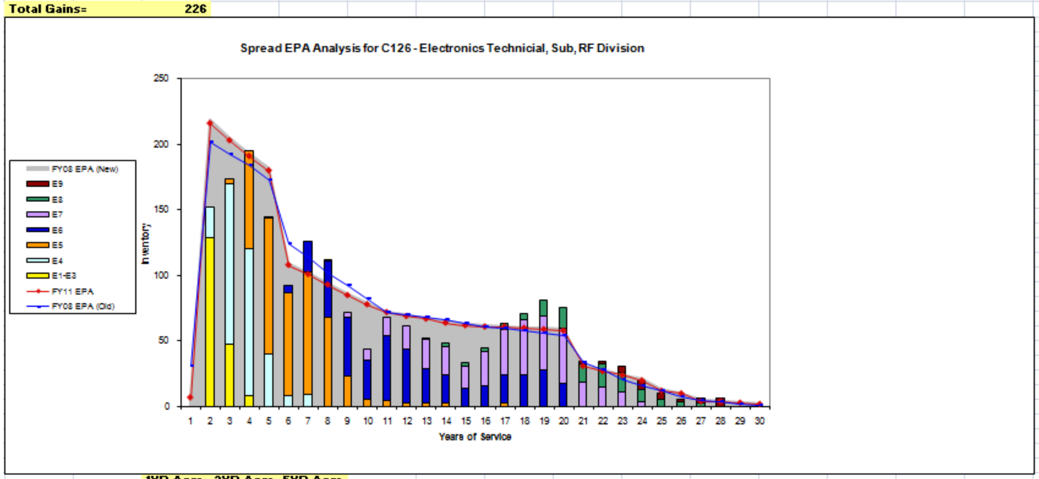
The table below is used by the user to input accessions by LOS. The output for the table is displayed on the below graphs, where current and proposed EPAs can be compared.

C126 - Electronics Technicial, Sub, RF Division

LOS	Default Community Gains (%)	Default Community Gains (#)	Proposed Community Gains (%)	Proposed Community Gains (#)	All Navy Continuation Rate	All Submarine (4011D9) Communities	Default Continuation Rate	Proposed Continuation Rate	Change Notes
1	0.11	21	0.00	0	0.79	0.85	1.00	0.94	
2	0.88	168	0.98	220	0.88	0.86	0.96	0.94	
3	0.01	2	0.02	6	0.91	0.89	0.95	0.94	
4	0.00	0	0.00	0	0.71	0.84	0.95	0.94	
5	0.00	0	0.00	0	0.71	0.66	0.65	0.55	
6	0.00	0	0.00	0	0.81	0.87	0.92	0.94	
7	0.00	0	0.00	0	0.89	0.91	0.91	0.92	
8	0.00	0	0.00	0	0.80	0.85	0.91	0.91	
9	0.00	0	0.00	0	0.87	0.86	0.87	0.91	
10	0.00	0	0.00	0	0.86	0.86	0.87	0.90	
11	0.00	0	0.00	0	0.91	0.89	0.96	0.94	
12	0.00	0	0.00	0	0.93	0.93	0.96	0.94	
13	0.00	0	0.00	0	0.95	0.90	0.96	0.94	
14	0.00	0	0.00	0	0.96	0.93	0.97	0.94	
15	0.00	0	0.00	0	0.96	0.93	0.97	0.99	
16	0.00	0	0.00	0	0.97	0.97	0.97	0.99	
17	0.00	0	0.00	0	0.98	0.96	0.97	0.99	
18	0.00	0	0.00	0	0.99	0.96	0.97	0.99	
19	0.00	0	0.00	0	0.99	0.97	0.97	0.99	
20	0.00	0	0.00	0	0.39	0.48	0.60	0.46	
21	0.00	0	0.00	0	0.75	0.76	0.80	0.86	
22	0.00	0	0.00	0	0.78	0.77	0.77	0.84	
23	0.00	0	0.00	0	0.78	0.75	0.76	0.82	
24	0.00	0	0.00	0	0.56	0.48	0.75	0.66	
25	0.00	0	0.00	0	0.77	0.71	0.67	0.74	
26	0.00	0	0.00	0	0.60	0.50	0.68	0.22	
27	0.00	0	0.00	0	0.80	0.67	0.68	0.80	
28	0.00	0	0.00	0	0.83	0.21	0.50	0.76	
29	0.00	0	0.00	0	0.87	0.33	0.50	0.69	
30	0.00	0	0.00	0	0.07	0.00	0.00	0.57	
Total:	**1**	**191**	**1**	**226**					

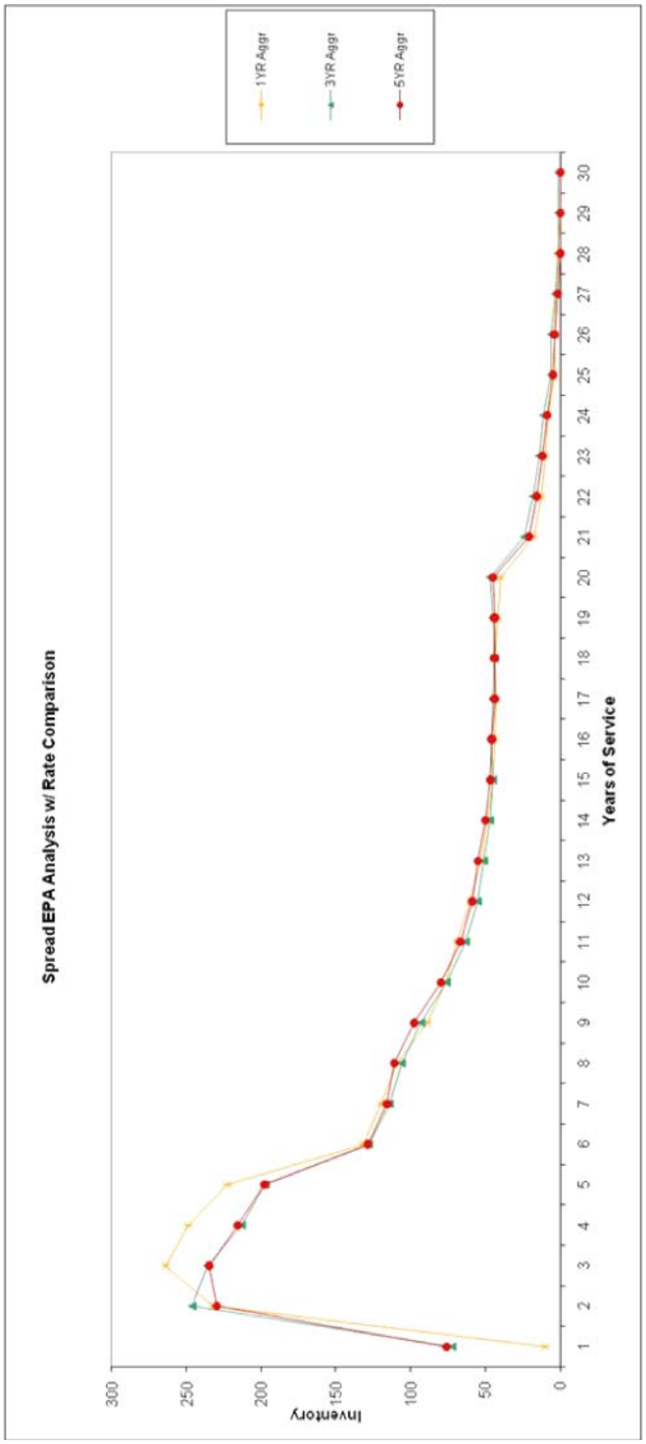
Propose New Continuation Rates | Adjust Gains | Submit SSI Changes for C126 | Submit SSI Changes for All Submarine (4011D9)

Total Gains= **226**



1YR Aggr	3YR Aggr	5YR Aggr
573	600	562

This graph below is the output of the proposed accessions by one, three or five year aggregates.



APPENDIX D USN CPO PERFORMANCE BY RATE

CYCLE: 194 PAYGRADE: E-7 USN NAVYWIDE PERFORMANCE BY ERATE

ERATE	GRP	TOTAL	SBE	% SBE	SEL	% SEL	FAIL	% FAIL	DISC	% DISC	SBE SS
ETC		885	550	62.1	124	22.5	8	0.9	0	0	57.56
ETNC	1	207	125	60.4	41	32.8	3	1.4	0	0	56.62
ETNC	2	127	74	58.3	17	23	3	2.4	0	0	54.68
ETRC		185	114	61.6	29	25.4	2	1.1	0	0	56.4
ETVC		239	151	63.2	74	49	6	2.5	0	0	56.07
FCC	1	463	294	63.5	78	26.5	3	0.6	0	0	55.32
FCC	2	295	177	60	42	23.7	3	1	0	0	58.63
FTC		138	85	61.6	22	25.9	3	2.2	0	0	57.15

CANDIDATE STATISTICS SUMMARY BY EXAM PAYGRADE

EPG	GRP	TOTAL	SBE	% SBE	SEL	% SEL	FAIL	% FAIL	DISC	% DISC	SBE SS
E7		32010	19697	61.5	4161	21.1	382	1.2	13	0	57.45

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APPENDIX E DMDC DATA FIELDS

Field	Description
SSN	ID
SVC	Service code
Type	E= Enlisted
FDate	Files as of Date
DOBYY	Date of Birth -Year
DOBMM	Date of Birth -Month
Gender	1= Male
REth	Race/Ethnic Code
PEBDYY	PER Pay Entry Base Date (Year)
PEBDMM	PER Pay Entry Base Date (Month)
BASDYY	PER Active Duty Base Date (month)
BASDMM	PER Active Duty Base Date (year)
DOLEYY	Date of Latest Enlistment (Year)
DOLEMM	Date of Latest Enlistment (Month)
MEPMS	Enlisted MEPCOM Marital/Family Status
AFQTCat	Enlisted MEPCOM AFQT Category (1980 Metric)
Race	New Race Coding (added April 2006)
Ethnic	Ethnic Group Coding (added April 2006)
Family.YYMM	Family Status
PG.YYMM	Pay Grade
PGMMM.YYMM	Months in Grade
Educ.YYMM	Education Level
PDOC.YYMM	Primary DoD Occupation Group
DDOC.YYMM	Duty DoD Occupation Group
MOS.YYMM	Service Specific Occupation Code
FTerm.YYMM	Enlisted First Term/Career Status
ETSMM.YYMM	Enlisted Months to ETS
UIC.YYMM	Unit Identification Code (UIC
DUTLOC.YYMM	Duty Location State/Country
MEMLOC.YYMM	Member Location
FSA.YYMM	Separation Allowance

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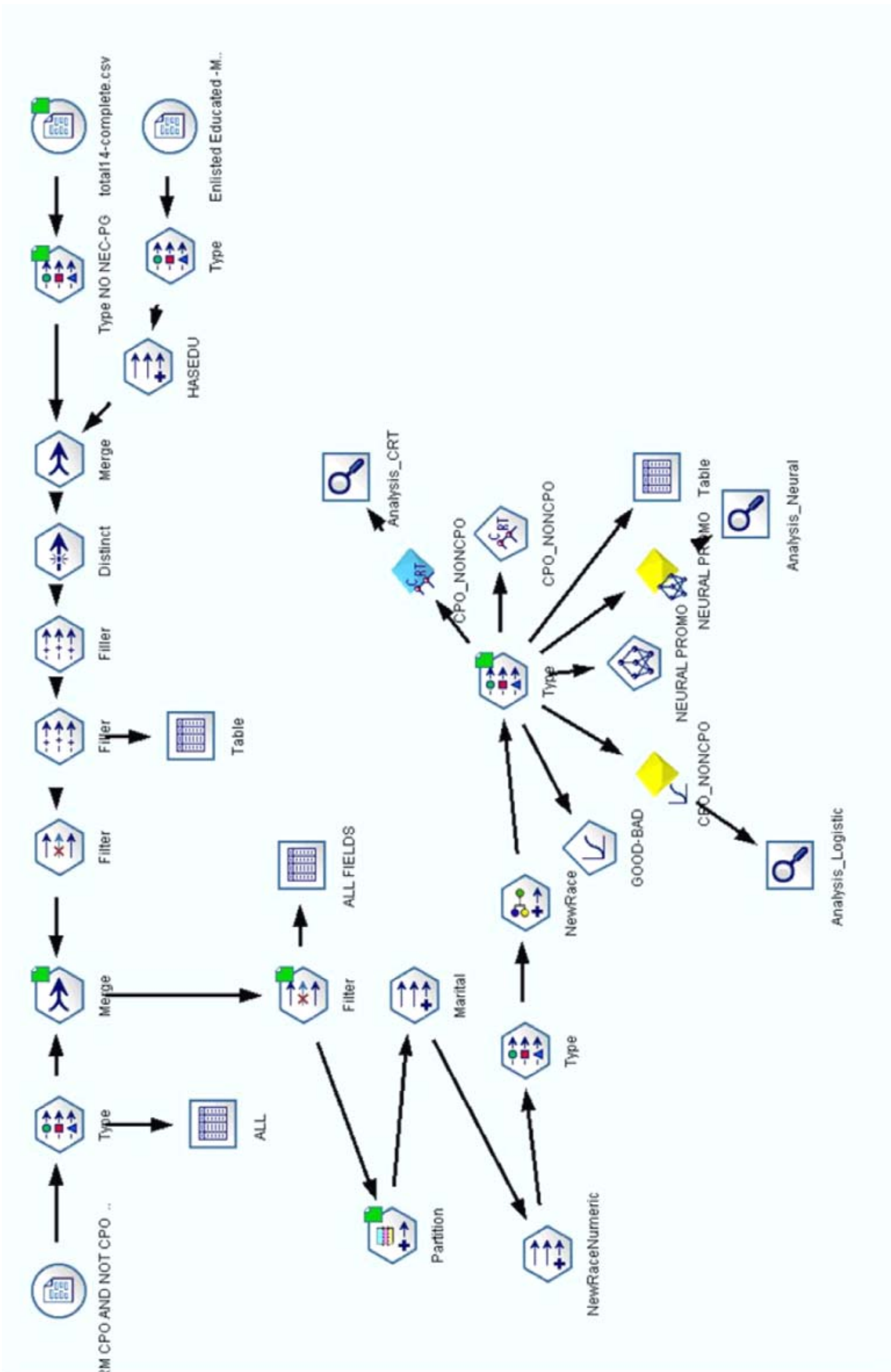
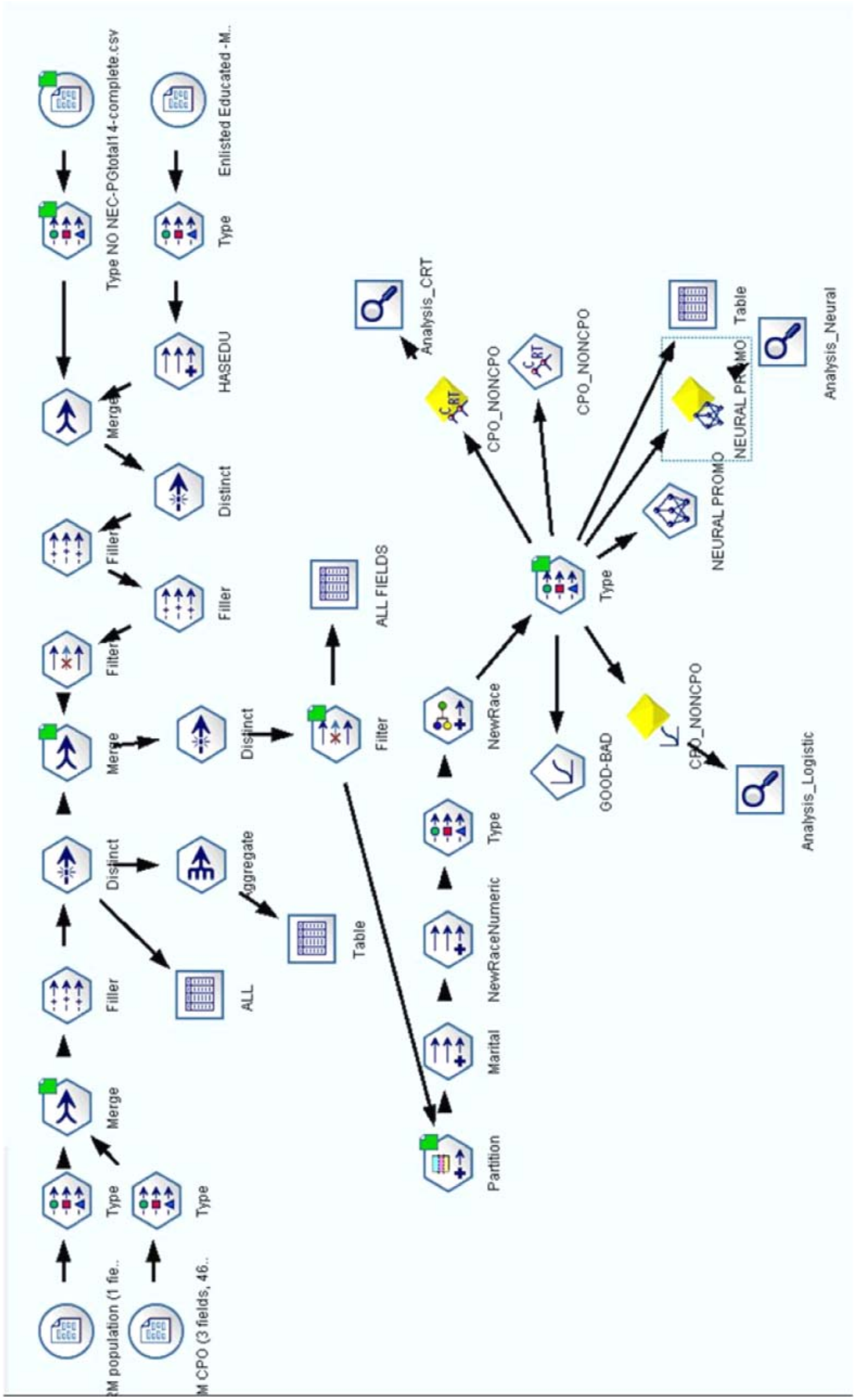
APPENDIX F CLEMENTINE NODES




Type NO NEC-PGtotal14-complete.csv
Enlisted Educated -M..
Type
HASEDU
Merge
Distinct
Filler
Filler
Filter
Merge
Distinct
Filter
ALL FIELDS
Distinct
Aggregate
Table
Filler
ALL
Merge
Type
Type
M population (1 fie..
M CPO (3 fields, 46..
Partition
Marital
NewRaceNumeric
Type
NewRace
Type
GOOD-BAD
CPO_NONCPO
Analysis_Logistic
NEURAL PROMO
NEURAL PROMO
Table
Analysis_Neural
CPO_NONCPO
CPO_NONCPO
Analysis_CRT

APPENDIX G "PROMOTABLE SET" REGRESSION RESULTS DETAIL

Warnings

Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.
The NOMREG procedure continues despite the above warning(s). Subsequent results shown are based on the last iteration. Validity of the model fit is uncertain.

Case Processing Summary

		N	Marginal Percentage
CPO_NONCPO	CPO	140	36.4%
	NOT_CPO	245	63.6%
PEBDMM	1	34	8.8%
	2	26	6.8%
	3	38	9.9%
	4	22	5.7%
	5	23	6.0%
	6	44	11.4%
	7	52	13.5%
	8	37	9.6%
	9	31	8.1%
	10	21	5.5%
	11	24	6.2%
	12	33	8.6%
AFQTCat	0	7	1.8%
	5	10	2.6%
	6	46	11.9%
	7	266	69.1%
	8	56	14.5%
MAX.EDU	0	7	1.8%
	1	6	1.6%
	2	329	85.5%
	3	30	7.8%
	4	11	2.9%
	5	2	.5%
Marital	MarriedWith	18	4.7%
	MarriedWithout	14	3.6%
	SingleWith	4	1.0%
	SingleWithout	349	90.6%
NewRace	Amerind	6	1.6%
	Asian	2	.5%
	Black	36	9.4%
	Hispanic	23	6.0%
	Other	1	.3%
	White	317	82.3%
Valid		385	100.0%
Missing		0	
Total		385	
Subpopulation		366(a)	

a. The dependent variable has only one value observed in 360 (98.4%) subpopulations.

Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	496.403			
Final	328.129	168.274	31	.000

Pseudo R-Square

Cox and Snell	.354
Nagelkerke	.485
McFadden	.333

Parameter Estimates

CPO_NONCPO(a)		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
NOT_CPO	Intercept	-21.819	3.631	36.103	1	.000			
	DOBYY	.012	.069	.031	1	.861	1.012	.883	1.160
	PEBDYY	.006	.096	.004	1	.953	1.006	.834	1.213
	DOLEYY	.256	.090	8.136	1	.004	1.292	1.083	1.541
	[PEBDMM=1]	-1.321	.651	4.127	1	.042	.267	.075	.955
	[PEBDMM=2]	-.917	.703	1.698	1	.193	.400	.101	1.587
	[PEBDMM=3]	-1.144	.669	2.926	1	.087	.318	.086	1.182
	[PEBDMM=4]	-.496	.829	.358	1	.550	.609	.120	3.094
	[PEBDMM=5]	-1.724	.768	5.034	1	.025	.178	.040	.804
	[PEBDMM=6]	-.831	.652	1.625	1	.202	.436	.121	1.564
	[PEBDMM=7]	-1.463	.613	5.693	1	.017	.231	.070	.770
	[PEBDMM=8]	-.964	.671	2.061	1	.151	.382	.102	1.422
	[PEBDMM=9]	-.355	.744	.227	1	.634	.701	.163	3.014
	[PEBDMM=10]	-1.303	.729	3.193	1	.074	.272	.065	1.134
	[PEBDMM=11]	-1.902	.828	5.274	1	.022	.149	.029	.757
	[PEBDMM=12]	0(b)	.	.	0	.	.	.	.
	[AFQTCat=0]	-.192	1.328	.021	1	.885	.825	.061	11.154
	[AFQTCat=5]	-.232	.916	.064	1	.800	.793	.132	4.776
	[AFQTCat=6]	-.742	.617	1.443	1	.230	.476	.142	1.597
	[AFQTCat=7]	-.847	.470	3.248	1	.072	.429	.170	1.077
	[AFQTCat=8]	0(b)	.	.	0	.	.	.	.
	[MAX.EDU=0]	16.735	5468.379	.000	1	.998	18522771.105	.000	.(c)
	[MAX.EDU=1]	-1.340	1.935	.480	1	.489	.262	.006	11.613
	[MAX.EDU=2]	-.602	1.648	.133	1	.715	.548	.022	13.859
	[MAX.EDU=3]	-1.644	1.717	.917	1	.338	.193	.007	5.588
	[MAX.EDU=4]	-2.364	1.916	1.522	1	.217	.094	.002	4.020
	[MAX.EDU=5]	0(b)	.	.	0	.	.	.	.
	[Marital=MarriedWith]	1.273	.888	2.052	1	.152	3.570	.626	20.368
	[Marital=MarriedWithout]	.283	.866	.107	1	.744	1.327	.243	7.244
	[Marital=SingleWith]	-1.833	1.326	1.910	1	.167	.160	.012	2.152
	[Marital=SingleWithout]	0(b)	.	.	0	.	.	.	.
	[NewRace=Amerind]	16.894	5965.975	.000	1	.998	21724602.376	.000	.(c)
	[NewRace=Asian]	15.860	.000	.	1	.	7725433.997	7725433.997	7725433.997
	[NewRace=Black]	-.004	.471	.000	1	.993	.996	.396	2.505
	[NewRace=Hispanic]	-.298	.572	.272	1	.602	.742	.242	2.275
	[NewRace=Other]	16.280	.000	.	1	.	11752267.859	11752267.859	11752267.859
	[NewRace=White]	0(b)	.	.	0	.	.	.	.

a. The reference category is: CPO.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

APPENDIX H "ALL RM SET" REGRESSION RESULTS DETAIL

Warnings

Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.
The NOMREG procedure continues despite the above warning(s). Subsequent results shown are based on the last iteration. Validity of the model fit is uncertain.

Case Processing Summary

		N	Marginal Percentage
CPO_NONCPO	CPO	168	14.0%
	NOT_CPO	1030	86.0%
PEBDMM	1	101	8.4%
	2	84	7.0%
	3	81	6.8%
	4	88	7.3%
	5	83	6.9%
	6	139	11.6%
	7	163	13.6%
	8	117	9.8%
	9	128	10.7%
	10	67	5.6%
	11	76	6.3%
	12	71	5.9%
AFQTCat	0	23	1.9%
	4	4	.3%
	5	45	3.8%
	6	179	14.9%
	7	819	68.4%
	8	128	10.7%
MAX.EDU	0	46	3.8%
	1	47	3.9%
	2	1026	85.6%
	3	49	4.1%
	4	27	2.3%
	5	3	.3%
Marital	MarriedWith	47	3.9%
	MarriedWithout	45	3.8%
	SingleWith	12	1.0%
	SingleWithout	1094	91.3%
NewRace	Amerind	36	3.0%
	Asian	40	3.3%
	Black	101	8.4%
	Hispanic	63	5.3%
	Other	9	.8%
	Unknown	1	.1%
	White	948	79.1%
Valid		1198	100.0%
Missing		0	
Total		1198	
Subpopulation		1067(a)	

a. The dependent variable has only one value observed in 1052 (98.6%) subpopulations.

Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	943.112			
Final	695.719	247.392	33	.000

Pseudo R-Square

Cox and Snell	.187
Nagelkerke	.336
McFadden	.255

Parameter Estimates

CPO_NONCPO(a)		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
NOT_CPO	Intercept	-15.977	2.365	45.636	1	.000			
	DOBYY	-.001	.045	.001	1	.977	.999	.915	1.091
	PEBDYY	.053	.058	.849	1	.357	1.055	.942	1.182
	DOLEYY	.149	.052	8.200	1	.004	1.161	1.048	1.286
	[PEBDMM=1]	-.134	.477	.079	1	.779	.875	.344	2.226
	[PEBDMM=2]	-.188	.510	.136	1	.713	.829	.305	2.253
	[PEBDMM=3]	-.209	.536	.152	1	.697	.811	.283	2.322
	[PEBDMM=4]	.037	.528	.005	1	.944	1.038	.369	2.922
	[PEBDMM=5]	-.408	.521	.614	1	.433	.665	.240	1.845
	[PEBDMM=6]	.406	.534	.578	1	.447	1.501	.527	4.272
	[PEBDMM=7]	-.091	.478	.036	1	.849	.913	.358	2.329
	[PEBDMM=8]	-.705	.482	2.137	1	.144	.494	.192	1.271
	[PEBDMM=9]	-.123	.481	.066	1	.797	.884	.345	2.267
	[PEBDMM=10]	-.502	.532	.889	1	.346	.605	.213	1.718
	[PEBDMM=11]	.316	.537	.347	1	.556	1.372	.479	3.927
	[PEBDMM=12]	0(b)	.	.	0	.	.	.	.
	[AFQTCat=0]	1.000	.920	1.182	1	.277	2.719	.448	16.492
	[AFQTCat=4]	-.718	1.089	.435	1	.510	.488	.058	4.121
	[AFQTCat=5]	.418	.580	.520	1	.471	1.519	.488	4.729
	[AFQTCat=6]	-.045	.412	.012	1	.914	.956	.427	2.143
	[AFQTCat=7]	-.324	.337	.922	1	.337	.724	.374	1.400
	[AFQTCat=8]	0(b)	.	.	0	.	.	.	.
	[MAX.EDU=0]	16.005	1755.220	.000	1	.993	8926956.154	.000	.(c)
	[MAX.EDU=1]	-.333	1.388	.057	1	.810	.717	.047	10.895
	[MAX.EDU=2]	-.189	1.276	.022	1	.882	.828	.068	10.107
	[MAX.EDU=3]	-1.109	1.325	.700	1	.403	.330	.025	4.431
	[MAX.EDU=4]	-1.269	1.367	.862	1	.353	.281	.019	4.098
	[MAX.EDU=5]	0(b)	.	.	0	.	.	.	.
	[Marital=MarriedWith]	-.810	.431	3.528	1	.060	.445	.191	1.036
	[Marital=MarriedWithout]	.249	.480	.268	1	.605	1.282	.500	3.286
	[Marital=SingleWith]	-1.272	.780	2.657	1	.103	.280	.061	1.293
	[Marital=SingleWithout]	0(b)	.	.	0	.	.	.	.
	[NewRace=Amerind]	16.065	1892.433	.000	1	.993	9481085.116	.000	.(c)
	[NewRace=Asian]	.442	.696	.403	1	.526	1.555	.397	6.088
	[NewRace=Black]	-.126	.359	.123	1	.726	.882	.436	1.783
	[NewRace=Hispanic]	-.620	.410	2.290	1	.130	.538	.241	1.201
	[NewRace=Other]	-1.427	1.237	1.331	1	.249	.240	.021	2.710
	[NewRace=Unknown]	16.771	.000	.	1	.	19206383.227	19206383.227	19206383.227
	[NewRace=White]	0(b)	.	.	0	.	.	.	.

a. The reference category is: CPO.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

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